QUESTION 1				
1.1	$k+5=\frac{14}{k}$			
	1.1.1	$k^2+5k-14=0$ $(k-2)(k+7)=0$ $k=2$ or $k=-7$	(3)	✓ multiplying ✓ factorising ✓ both solutions
	1.1.2	$\sqrt{x+5}=2$ or $\sqrt{x+5}=-7$ $x+5=4$ or invalid/ no solution $x=-1$	(3)	✓ substitution ✓ identifying invalid ✓ value of x
1.2	1.2.1	$\lvert 5-x\rvert=9$ $5-x=9$ or $-(5-x)=9$ $x=-4$ or $x=14$	(3)	✓ interpretation/ use definition ✓✓ each value one
	1.2.2	$\frac{2x-2}{x-3}>3$ $\frac{2x-2}{x-3}-3>0$ $\frac{2x-2-3(x-3)}{x-3}>0$ $\frac{2x-2-3x+9}{x-3}>0$ $\frac{7-x}{x-3}>0$ **OR** $\frac{x-7}{x-3}<0$ $3<x<7$	(5)	✓ transfer of 3 ✓ common denominator ✓ simplification ✓✓ answer
1.3	$\frac{1}{x}+\frac{1}{y}=3$ .... (1) $x-y=\frac{1}{2}$ .... (2) From (2): $x=y+\frac{1}{2}$ .... (3) Substituting (3) in (2) yields: $\frac{1}{y+\frac{1}{2}}+\frac{1}{y}=3$ $y+y+\frac{1}{2}=3y\left(y+\frac{1}{2}\right)$ $4y+1=3y(2y+1)=6y^2+3y$ $6y^2-y-1=0$ $(2y-1)(3y+1)=0$ $y=\frac{1}{2}$ or $y=-\frac{1}{3}$ $x=\frac{1}{2}+\frac{1}{2}$ or $x=-\frac{1}{3}+\frac{1}{2}$ $=1$ or $=\frac{1}{6}$ i.e. $\left(\frac{1}{2};1\right)$ or $\left(-\frac{1}{3};\frac{1}{6}\right)$		(8) **[22]**	✓ equation (3) ✓ substitution ✓ simplification ✓ standard form ✓ factors ✓ both y values ✓✓ each x-value gets 1

	Alternative solution:		
	From (1): $y+x=3xy$ .... (4)		✓ equation (4)
	Substitute (3) in (4) :		
	$y+y+\frac{1}{2}=3y\left(y+\frac{1}{2}\right)$		✓ substitution
	$2y+\frac{1}{2}=3y^2+\frac{3}{2}y$		
	$4y+1=6y^2+3y$		
	$\therefore\ 6y^2-y-1=0$		✓ standard form
	$(2y-1)(3y+1)=0$		✓ factors
	$y=\frac{1}{2}$ or $y=-\frac{1}{3}$		✓ both y values
	$\therefore\ x=1$ or $x=\frac{1}{6}$		✓✓ each x-value gets 1

QUESTION 2

2.1	$4x-5=k\left(x^2-1\right)$		
	$kx^2-4x+5-k=0$		✓ standard form
	$\Delta=b^2-4ac$		
	$=(-4)^2-4(k)(5-k)$		✓ substitution
	$=16-20k+4k^2$		✓ simplifying
	For equal roots : $\Delta=0$		✓ equating Δ to 0
	i.e. $4k^2-20k+16=0$		
	$4(k-4)(k-1)=0$		✓ factors
	$k=4$ or $k=1$	(6)	✓ both values of k
2.2	$x^2+p=(p+2)x$		✓ standard form
	$x^2-(p+1)x+p=0$		
	$\Delta=[-(p+1)]^2-4(1)(p)$		✓use of Δ
	$=p^2+2p+1-4p$		✓substitution
	$=p^2-2p+1$		✓simplifying
	$=(p-1)^2$		
	$x^2-px+p-x=0$ $x(x-p)-(x-p)=0$ $(x-1)(x-p)=0$ $x=1$ or $x=p$ both of which are rational		
	Δ is a perfect square; $\therefore$ roots are rational for all rational p	(5) **[11]**	✓expressing as perfect square and conclusion

QUESTION 3

3.1	$(-1)^3+p(-1)+r=-9$		✓substitution
	$\therefore\ r-p=-8$ .... (1)		✓equating to 9
	$(1)^3+p(1)+r=-1$		✓substitution
	$\therefore\ r+p=-2$ .... (2)		✓equating to -1
	(1) + (2): $2r=-10$		
	$r=-5$		✓value of r
	$\therefore\ p=3$	(6)	✓value of p

3.2	Let $f(x)=3-7x+5x^2-x^3$ $f(1)=3-7(1)+5(1)^2-(1)^3$ $=3-7+5-1=0$ $\therefore\ x-1$ is a factor of $f(x)$ $f(x)=(x-1)\left(-x^2+4x-3\right)$ $=(x-1)(x-1)(3-x)$ $f(x)=0$ $\therefore\ x=3$ or $x=1$	(6) **[12]**	✓ ✓ finding a factor ✓✓ quadratic factor ✓ linear factors ✓both values of x

QUESTION 4

4.1	$f(x)=ax^2+bx+c$ and $g(x)=\lvert x-2\rvert$			
	4.1.1	C (0 ; 2) and D (4 ; 2) : $\boxed{g(0)=\lvert 0-2\rvert=2}$	(3)	✓ C D: ✓ $x=4$ ✓ $y=2$
	4.1.2	$y=a(x-p)^2+q$ At A (2 ; 4): $y=a(x-2)^2+4$ Subst C(0 ; 2): $2=a(0-2)^2+4$ $-2=4a$ $\therefore\ a=-\frac{1}{2}$ $\therefore\ y=-\frac{1}{2}(x-2)^2+4$ $=-\frac{1}{2}\left(x^2-4x+4\right)+4$ $y=-\frac{1}{2}x^2+2x+2$ $\therefore\ b=2;\ c=2$	(5)	✓ subst. Turning pt. ✓ subst C or D ✓ value of a ✓ simplification ✓ equation
	4.1.3	$-\frac{1}{2}x^2+2x+2=0$ $x^2-4x-4=0$ $x=\dfrac{4\pm\sqrt{16+16}}{2}$ or $x=\dfrac{-2\pm\sqrt{4+4}}{-1}$ $=2\pm2\sqrt{2}$ $=4{,}83$ or $-0{,}83$ E (–0,83 ; 0) & H (4,83 ; 0)	(4)	✓standard form ✓subst in formula ✓x-value of E ✓x-value of H
	4.1.4	(a) $x\le0$ or $x\ge4$ (b) $x\le-0{,}83$ or $x\ge4{,}83$	(2) (4)	✓✓ one mark per inequality ✓✓✓✓ two marks per inequality
4.2	$h(x)=\log_a x$ & A(8 ; 3)			
	4.2.1	$y=\log_a x$ $3=\log_a 8$ $3=3\log_a 2$ **OR** $\boxed{\begin{array}{l}8=a^3\\2^3=a^3\end{array}}$ $1=\log_a 2$ $\therefore\ a=2$	(3)	✓ substitution ✓ exp. form or $8=2^3$ ✓ answer
	4.2.2	B (1 ; 0)	(1)	✓ answer

	4.2.3	$x=\log_2 y$ **OR** $y=2^x$ $\therefore\ h^{-1}(x)=2^x$ or a^x $y=\log_2 x$ $x=2^y$ $y=2^x$	(2)	✓either expression ✓correct form
	4.2.4	$h^{-1}(3)=2^3=8$ **OR** $h(8)=3\ \therefore\ h^{-1}(3)=8$	(1)	✓ answer
	4.2.5	$x>0$	(1) **[26]**	✓ answer

QUESTION 5

5.1	5.1.1	$\sqrt{\frac{8}{3}}+5\sqrt{\frac{2}{3}}-\sqrt{\frac{1}{6}}=\frac{13}{2}\sqrt{\frac{2}{3}}$ LHS $=2\sqrt{\frac{2}{3}}+5\sqrt{\frac{2}{3}}-\sqrt{\frac{2}{12}}$ $=7\sqrt{\frac{2}{3}}-\frac{1}{2}\sqrt{\frac{2}{3}}$ $=\left(6\frac{1}{2}\right)\sqrt{\frac{2}{3}}$ $=\frac{13}{2}\sqrt{\frac{2}{3}}$ = RHS $\frac{1}{6}=\frac{2}{12}=\frac{1}{4}.\frac{2}{3}$	(4)	✓$2\sqrt{\frac{2}{3}}$ ✓ $\frac{1}{6}=\frac{1}{4}.\frac{2}{3}$ ✓$\frac{1}{2}\sqrt{\frac{2}{3}}$ ✓addition
	5.1.2	$\log\frac{75}{16}-2\log\frac{5}{9}+\log\frac{32}{243}=\log 2$ LHS $=\log\left(\frac{75}{16}\times\frac{32}{243}\right)-\log\frac{25}{81}$ $=\log\left(\frac{50}{81}\div\frac{25}{81}\right)$ $=\log\left(\frac{50}{81}\times\frac{81}{25}\right)$ $=\log 2$ = RHS $\log\frac{\left(\frac{75}{16}\times\frac{32}{243}\right)}{\frac{25}{81}}$ $=\log\frac{75}{16}\times\frac{32}{243}\times\frac{81}{25}$ $=\log\frac{3.5^2}{2^4}\times\frac{2^5}{3^5}\times\frac{3^4}{5^2}$ $=\log 2$	(4)	✓application of "product" rule ✓ $-\log\frac{25}{81}$ ✓application of "quotient" rule ✓simplification
5.2	5.2.1	$2^{2x+1}-3.2^x+1=0$ $2.2^{2x}-3.2^x+1=0$ $(2.2^x-1)(2^x-1)=0$ $2^x=\frac{1}{2}$ or $2^x=1$ $2^x=2^{-1}$ or $2^x=2^0$ $x=-1$ or $x=0$	(5)	✓$2^{2x+1}=2.2^x$ ✓factors ✓split equations ✓one value of x ✓other value of x
	5.2.2	$\log_2 9x+\log_4 x^2=2$ $\frac{\log 9x}{\log 2}+\frac{\log x^2}{\log 4}=2$ $\frac{\log 9x}{\log 2}+\frac{\log x}{\log 2}=2$ $\log 9x+\log x=2\log 2$ $\log 9x^2=\log 4$ $9x^2=4$ $x^2=\left(\frac{2}{3}\right)^2$ $x=\frac{2}{3}$	(6)	✓ change of base ✓ simplification ✓ multiplying by LCD ✓ simplifying LHS ✓ simplifying RHS ✓answer ($x>0$)

	5.2.3	$\log_{\frac{1}{2}} 3x > 2$ $\log_{\frac{1}{2}} 3x > 2\log_{\frac{1}{2}} \frac{1}{2}$ **OR** $\boxed{3x < \left(\frac{1}{2}\right)^2 \quad \checkmark\checkmark}$ $3x < \frac{1}{4}$ $x < \frac{1}{12}$ but $x > 0$ by definition $\therefore\ 0 < x < \frac{1}{12}$	(5)	✓exponential form ✓with correct < ✓$x < \frac{1}{12}$ ✓$x > 0$ definition ✓ answer
5.3	$2^x.3^{x+1} = 10$ $2^x.3^x.3 = 10$ $6^x = \frac{10}{3}$ $x = \log_6 \frac{10}{3}$ OR $= \frac{\log 10 - \log 3}{\log 6}$ $= 0,67$	$\log 6^x = \log\frac{10}{3}$ $x = \frac{\log\frac{10}{3}}{\log 6}$ $= 0,67$	(5) [29]	✓taking out 3 ✓6^x form ✓taking logs ✓x as subject ✓answer

QUESTION 6

6.1	$S_n = \frac{5}{2}n^2 + \frac{7}{2}n$			
	6.1.1	$T_1 = S_1$ $= \frac{5}{2}(1)^2 + \frac{7}{2}(1)$ $= \frac{12}{2} = 6$	(3)	✓ statement ✓ substitution ✓ answer
	6.1.2	$S_2 = \frac{5}{2}(2)^2 + \frac{7}{2}(2)$ $= 10 + 7 = 17$ $T_2 = S_2 - S_1$ $= 17 - 6 = 11$ $\therefore\ d = T_2 - T_1$ $= 11 - 6 = 5$	(5)	✓ T_2 equation ✓ value of S_2 ✓ value of T_2 ✓ d equation ✓ value of d
	6.1.3	$T_{10} = a + 9d$ $= 6 + 9(5)$ $= 51$ **OR** $T_{10} = S_{10} - S_9$ $= \frac{5}{2}(10)^2 + \frac{7}{2}(10) - \frac{5}{2}(9)^2 - \frac{7}{2}(9)$ $= \frac{1}{2}(500 + 70 - 405 - 63)$ $= \frac{1}{2}(102)$ $= 51$	(2)	✓ formula ✓ answer ✓ substitution ✓ answer

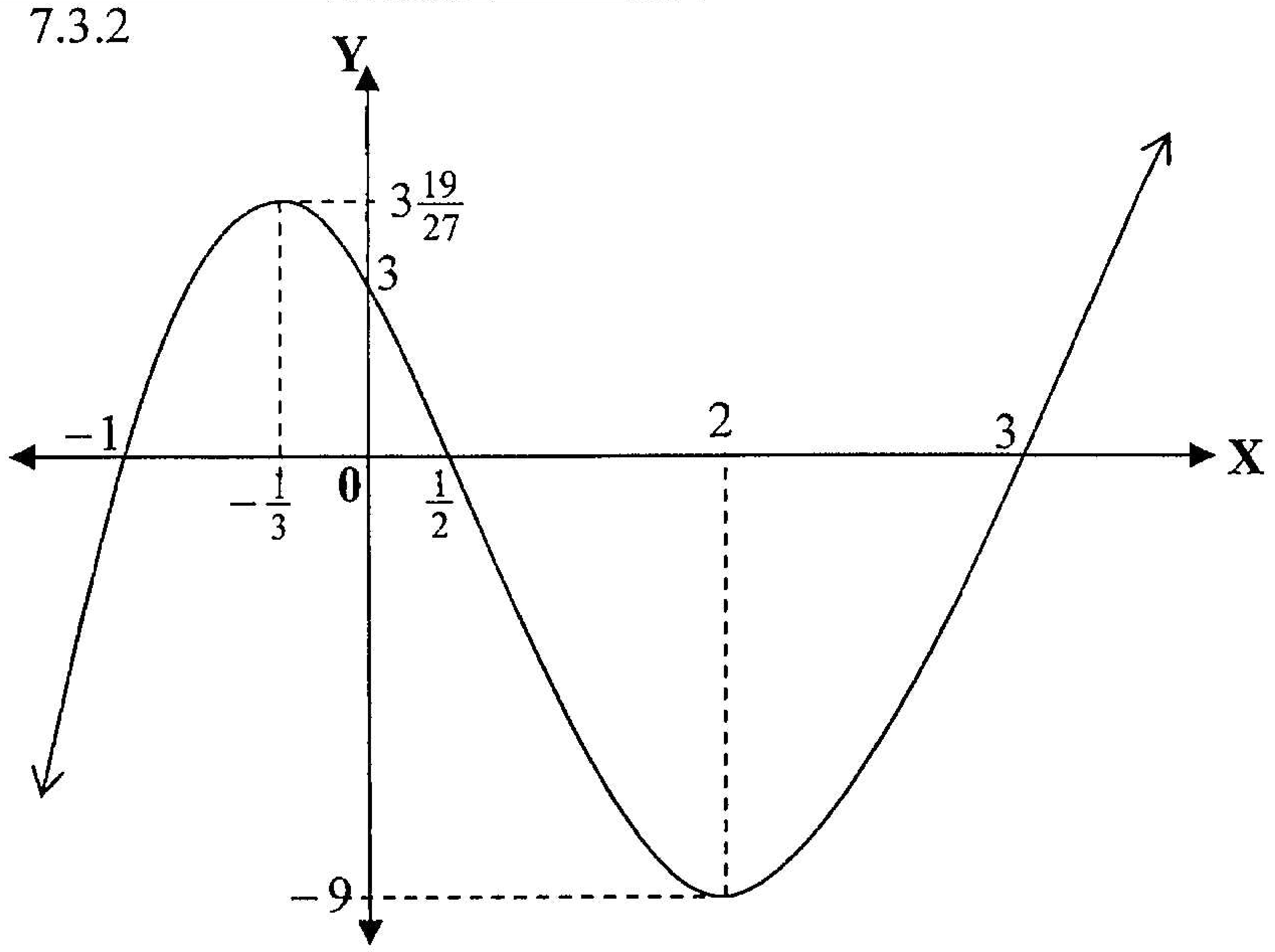
6.2	$\underbrace{1+2+3+\ldots}_{n} = 630$		

	6.2.1	$S_n = \frac{n}{2}[2a+(n-1)d]$ $630 = \frac{n}{2}(2+n-1)$ $1260 = n^2+n$ $n^2+n-1260=0$ $(n+36)(n-35)=0$ $n \neq -36$ or $n = 35$ $\therefore$ there are 35 rows in the stack $\boxed{\begin{array}{l} n = \frac{-1\pm\sqrt{5041}}{2} \\ = \frac{-1+71}{2} \text{ or } \frac{-1-71}{2} \\ = 35 \end{array}}$	(5)	✓choice of formula ✓correct substitution ✓standard form ✓factors ✓answer (correct conclusion)
	6.2.2	$T_n = a+(n-1)d$ $T_{35} = 1+(35-1)(1)$ $= 35$ **OR** By inspection $T_{35} = 35$	(1)	✓answer
6.3		$\sum_{k=1}^{x} 3^k = 1\,092$ $3 + 9 + 27 + \ldots + 3^x = 1\,092$ $S_n = \frac{a(r^n-1)}{r-1}$ $1\,092 = \frac{3(3^x-1)}{3-1}$ $728 = 3^x - 1$ $3^x = 729 = 3^6$ $x = 6$	(6)	✓ expansion ✓choice of formula ✓substitution ✓ 729 ✓3^6 ✓answer

6.4	6.4.1	$r = \frac{T_{n+1}}{T_n} = \frac{3(m-1)^{n+2}}{3(m-1)^{n+1}}$ $= m-1$ is a constant. $\therefore$ sequence is geometric	(3)	✓ r in terms of T & n ✓$m-1$ ✓ a constant
	6.4.2	$\lvert m-1 \rvert < 1$ $\therefore \quad -1 < m-1 < 1$ $0 < m < 2$ $S_\infty = \frac{a}{1-r}$ $= \frac{3(m-1)^2}{1-(m-1)}$ $= \frac{3(m-1)^2}{2-m}$ **OR** $S_\infty = \frac{3m^2-6m+3}{2-m}$	(6) **[31]**	✓ statement ✓without absolute valu ✓✓ value of m ✓ formula ✓ answer

QUESTION 7				
7.1		$f(x)=x^2-6x$ $f(x+h)=(x+h)^2-6(x+h)=x^2+2xh+h^2-6x-6h$ $\frac{f(x+h)-f(x)}{h}=\frac{2xh-6h+h^2}{h}$ $=2x-6+h$ $f'(x)=\lim\limits_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim\limits_{h\to 0}(2x-6+h)$ $=2x-6$	(6)	✓subst ✓ simplification ✓ difference ✓ dividing by h ✓ use of formula ✓ answer
7.2	7.2.1	$y=(2x)^2-\frac{1}{3x}$ $=4x^2-\frac{1}{3}x^{-1}$ $\frac{dy}{dx}=8x+\frac{1}{3}x^{-2}$	(3)	✓ simplifying ✓✓ derivative of each term
	7.2.2	$y=\frac{2\sqrt{x}-5}{\sqrt{x}}$ $=2-5x^{-\frac{1}{2}}$ $\frac{dy}{dx}=+\frac{5}{2}x^{-\frac{3}{2}}$	(4)	✓✓ simplifying each term ✓✓ derivative

7.3	7.3.1	For <u>turning points</u>: $f'(x)=0$ $6x^2-10x-4=0$ $2(3x+1)(x-2)=0$ $x=-\frac{1}{3}$ or $x=2$ $f\left(-\frac{1}{3}\right)=2\left(-\frac{1}{27}\right)-5\left(\frac{1}{9}\right)-4\left(-\frac{1}{3}\right)+3$ $=3\frac{19}{27}$ $f(2)=2(8)-5(4)-4(2)+3=-9$	(6)	✓derivative ✓= 0 ✓factors ✓x-values ✓one y-value ✓other y-value

7.3.2			(5)	✓one turning pt ✓other turning pt ✓x-intercepts ✓y-intercept ✓shape
	7.3.3	$k = 9$ or $k = -3\frac{19}{27}$	(4)	✓✓ per solution
	7.3.4	Gradient of tangent $m_T = f'(x)$ i.e. $m_T = 6x^2 - 10x - 4$ at $x = 1$: $m_T = 6 - 10 - 4 = -8$ $f(1) = 2 - 5 - 4 + 3 = -4$ $\therefore$ point of contact is $(1 ; -4)$ $y = mx + c$ subst m_T and point: $-4 = (-8)(1) + c$ $\therefore \quad c = 4$ $\therefore \quad y = -8x + 4$	(6) **[34]**	✓ know that $m_T = f'(x)$ ✓ $m_T = -8$ ✓ $f(1) = -4$ ✓ formula ✓ substitution ✓ equation

QUESTION 8				
8.1	$P(x) = \frac{55}{2x} + \frac{x}{200}$			
	8.1.1	Petrol consumption rate: $P(x) = \frac{55}{2x} + \frac{x}{200}$ For 2 000 km, the amount of petrol consumed is: $2000\left(\frac{55}{2x} + \frac{x}{200}\right) = \frac{55000}{x} + 10x$ litres Petrol costs $= 4\left(\frac{55000}{x} + 10x\right) = \frac{220000}{x} + 40x$ rands Hours traveled $= \frac{2000}{x}$ Driver's earnings $= \frac{2000}{x}.18 = \frac{36000}{x}$ rands C (x) = petrol + driver $= \frac{220000}{x} + 40x + \frac{36000}{x}$ $= \frac{256000}{x} + 40x$	(6)	✓ petrol used ✓✓ petrol cost ✓ hours traveled ✓driver's earnings ✓ cost equation

	8.1.2	For minimum costs: $C'(x) = 0$ $-\dfrac{256000}{x^2} + 40 = 0$ $40x^2 - 256000 = 0$ $x^2 = 6400$ $x = 80$ km/h	(5)	✓✓ derivative (each term) ✓ = 0 ✓ multiplying/ std form ✓answer

8.2	$T(t) = 30 + 4t - \frac{1}{2}t^2$			
	8.2.1	$T'(t) = 4 - t$ **OR** $\dfrac{dT}{dt} = 4 - t$	(2)	✓✓derivative (each term)
	8.2.2	$T'(t) \leq 0$ $4 - t \leq 0$ $t \geq 4$ $\therefore\ 4 \leq t \leq 10$	(4) **[17]**	✓✓ statement ✓ t – subject ✓ answer

QUESTION 9			
9.1	$x \leq 150$ .... (1) $y \leq 120$ .... (2) $x + y \leq 200$ .... (3) $x \geq 40$ .... (4) $y \geq 10$ ....(5)	(4)	✓ for ...(2) ✓ for... (3) ✓ for....(4) ✓ for ...(5)
9.2	See graph	(6)	✓✓✓✓✓ lines ✓ shading
9.3	P = $5x$ + $10y$	(2)	✓✓equation
9.4	Search line on graph : $y = -\frac{1}{2}x + \frac{P}{10}$	(2)	✓✓search line
9.5	Maximum at A Coordinates of A (50 ; 80) $P = 5(80) + 10(120)$ = R 1 600	(4)	✓ statement ✓ coordinates of A ✓substitution ✓answer
		[18]	
T O T A L		**200**	

QUESTION 9

EXAMINATION NUMBER													
CENTRE NUMBER